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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of)	Art Unit: 2175
)	
Q. CHEN ET AL.)	Examiner: WU, YICUN
)	
Serial No.: 09/523,446)	
)	
Filing Date Mar. 10, 2000)	
)	
For: OLAP-Based Customer)	
Behavior Profiling)	
Method and System)	

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BRIEF ON APPEAL

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STATUS OF CLAIMS

Applicant appeals claims 2-18, 20, 22-25 and 27-30 of the pending claims. All of the pending claims have been rejected in the Final Office Action, mailed September 10, 2002, under 35 U.S.C. § 103(a) as being unpatentable over an article entitled, "Towards On-Line Analytical Mining in Large Databases," by Jiawei Han (hereinafter Han) in view of U.S. Patent No. 6,236,978 issued to Tuzhilin, (hereinafter Tuzhilin) further in view of U.S. Patent No. 5,790,645 issued to Fawcett et al. (hereinafter Fawcett).

STATUS OF AMENDMENTS

An amendment was filed subsequent to final rejection on December 10, 2002, amending claims 2-18, 20, 22-25 and 27-30. The after-final amendments have been entered by the Examiner for the purposes of this appeal (see Advisory Action of January 15, 2003).

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SUMMARY OF INVENTION

A first embodiment of an OLAP-based method for detecting telecommunication fraud according to the present invention system is illustrated in Figures 1-4. First, a plurality of call records from the data warehouse are retrieved (e.g., steps 300 and 308). Next, a calling profile cube based on the call records is generated (e.g., steps 304, 312 or 316). The calling profile cube includes information on multiple customers. A volume-based calling pattern cube is then generated for each individual customer based on the multi-customer calling profile cube (step 318). The volume-based calling pattern cube for each customer may then be compared with predetermined fraudulent volume-based calling patterns by behavior pattern comparison module (BPCM 168 of FIG. 2), for example. When the volume-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent volume-based calling pattern, performing a first action.

A second embodiment of an OLAP-based method for detecting telecommunication fraud according to the present invention system is illustrated in Figures 1-4 and employs probability-based fraudulent patterns. In this embodiment, after the volume-based calling pattern cube (e.g., a calling pattern cube for each individual customer) has been generated, a probability-based calling pattern cube is generated based on the volume-based calling pattern cube by a volume-based to probability-based conversion module (VPCM 164 of FIG. 2), for example. The probability-based calling pattern may then be compared with known probability-based fraudulent patterns by behavior pattern comparison module (BPCM 168 of FIG. 2). If the similarities generated by the comparison reaches or exceeds a predetermined threshold, then the particular caller with the calling pattern being analyzed is considered

suspicious. One advantage of the second embodiment over the first embodiment described above is that two patterns that cover different time periods can be compared and analyzed.

ISSUE

Whether claims 2, 4-14, 16-18, 20, 22-25, 27-30 are patentable under 35 U.S.C. 103(a) over Jiawei Han (“Towards On-Line Analytical Mining in Large Databases”, hereinafter the Han reference) in view of U.S. Patent No. 6,236,978 to Tuzhilin, (hereinafter Tuzhilin) further in view of U.S. Patent No. 5,790,645 to Fawcett et al. (hereinafter Fawcett).

GROUPING OF CLAIMS

For each ground of rejection which appellant contests herein that applies to more than one claim, such additional claims, to the extent separately identified and argued below, do not stand or fall together.

THE ARGUMENT

Issue – Whether claims 2, 4-14, 16-18, 20, 22-25, 27-30 are patentable under 35 U.S.C. 103(a) over Jiawei Han (“Towards On-Line Analytical Mining in Large Databases”, hereinafter the Han reference) in view of U.S. Patent No. 6,236,978 to Tuzhilin, (hereinafter Tuzhilin) further in view of U.S. Patent No. 5,790,645 to Fawcett et al. (hereinafter Fawcett).

Claim 27

Paragraph 10 on page 5 of the Final Action refers to FIG. 1 and page 3, paragraph 4 of Han for teaching the first two steps recited by independent claim 27. Specifically, FIG. 1, and page 3, paragraph 4 of Han are referenced. However, it is respectfully submitted that Han fails to teach or suggest the steps of “retrieving a plurality of call records from the data

warehouse,” and “generating a calling profile cube based on the call records; wherein the calling profile cube includes information on multiple customers.”

For example, Figure 1 of Han illustrates an integrated on-line analytical mining (OLAM) on-line analytical processing (OLAP) architecture that shows a generic data cube. However, FIG. 1 of Han fails to teach or suggest, “generating a calling profile cube based on the call records; wherein the calling profile cube includes information on multiple customers,” as claimed.

Furthermore, Section 2.2 entitled Data Cube Construction describes very generally how data cube technology is important to on-line analytical mining. However, besides these broad generalization, the contents of the specific data cubes employed, how the specific data cubes are generated, and how these data cubes are used in a specific application according to the claimed invention are not taught or suggested.

Moreover, it is respectfully submitted that the data cube illustrated in Han and related description on page 3 only describes a generic data cube or cuboid. However, Han does not appear to fairly teach or suggest the step of “generating a calling profile cube based on the call records; wherein the calling profile cube includes information on multiple customers.” as claimed.

The Final Action admits that the following steps:

generating a volume-based calling pattern cube for each individual customer based on
the multi-customer calling profile cube;
comparing the volume-based calling pattern cube for each customer to a
predetermined fraudulent volume-based calling pattern; and
when the volume-based calling pattern cube is in a first predetermined relationship
with predetermined fraudulent volume-based calling pattern, performing a first
action

are not taught by Han. However, the Final Action cites the Tuzhilin reference for teaching those steps (see page 6 of the Final Action) that are not taught by the Han reference. In particular, FIGS. 1-3 and col. 3, lines 40-41 of Tuzhilin are cited as teaching the above-noted steps.

However, it is respectfully submitted that Tuzhilin fails to fairly teach the steps of “generating a volume-based calling pattern for each individual customer based on the multi-customer calling profile,” and “comparing the volume-based calling pattern cube for each customer to a predetermined fraudulent volume-based calling pattern,” as claimed.

As argued below, appellant believes that the combination of Han, Tuzhilin, and Fawcett to be improper. However, even if Han and Tuzhilin and Fawcett were to be properly combined, which is not conceded, it is respectfully submitted that one skilled in the art would not arrive at the invention as claimed by combining the Han, Tuzhilin, and Fawcett references.

Although FIGS. 1-3 of Tuzhilin are referenced by the Final Action as teaching the above-noted limitations, a review of these figures leads one to conclude that these FIGS. 1-3 do not appear to teach or suggest the limitations of the claimed invention.

For example, Figure 1 of Tuzhilin illustrates a process for generating a user profile. The general flowchart has the following steps: 1) retrieve user's past purchasing history, 2) build user profile based on (1) and 3) complete process when profile complete. (See Col. 3, lines 36 to 40). Figure 2 is a flowchart describing the generation of static and dynamic user profiles and provides more details of how a static profile and a dynamic profile are built for each user. FIG. 3 illustrates specific steps, such as, the step of compressing dynamic rules

(step 35), generating aggregate rules (40), validating the aggregate rules by human expert (45) and validating individual rules (60).

However, FIGS. 1-3 of Tuzhilin do not appear to teach or suggest the step of “generating a volume-based calling pattern for each individual customer based on the multi-customer calling profile.”

Furthermore, in contrast to the claimed invention, the user profiles of Tuzhilin appear to be generated directly from past purchase histories (e.g., a customer file (CUST) and a transaction file (TRANS)). Col. 5, lines 1-15 generally describes the process of generating user-specific rules (dynamic profile construction) according to Tuzhilin, which uses fields from a transaction file to generate rules and assigning the rules to a customer. The Tuzhilin method is very different from the claimed method, which uses specific intermediate steps to generate a customer calling profile as claimed.

Moreover, Tuzhilin appears to teach the use of individual profiles, whether static or dynamic, instead of a multi-customer calling profile as claimed.

Furthermore, col. 3, lines 31-37 of the Tuzhilin reference is directed at building a “user’s past purchasing history,” and not the specific limitations of the claimed invention.

Stated differently, the Tuzhilin approach to generating customer profile is very different from the claimed method. Furthermore, the figures and related description of the Tuzhilin reference do not fairly teach or suggest the step of “generating a volume-based calling pattern for each individual customer based on the multi-customer calling profile,” as claimed. Perhaps, the Action can cite a particular portion or element that specifically teaches the specific processing as claimed.

The Action further refers to FIGS. 1-3, col. 11, line 65, and col. 3, line 40-41 of Tuzhilin as teaching the step of “comparing the volume-based calling pattern for each customer to a predetermined fraudulent volume-based calling pattern.”

The above-noted cited portions appear to be directed to using the purchasing history of a user (provided by Purchasing History Storage Unit 120), a user’s profile (provided by User Profile Generation 110) and external information about the user (provided by State of the User Module 160) to estimate a user’s future purchasing needs (col. 11, lines 42-52), which is generally un-related to the specific limitations of the claimed invention.

Furthermore, the User Estimated Purchasing Needs module 140 and its operation is not the same nor does it teach or suggest the step of “comparing the volume-based calling pattern for each customer to a predetermined fraudulent volume-based calling pattern,” as claimed.

Claim 28

The references, whether alone or in combination, fail to teach or suggest the generation or use of a probability-based calling pattern cube in connection with a method of detecting telecommunication fraud as claimed. Specifically, claim 28 recites, “generating a probability-based calling pattern cube based on the volume-based calling pattern cube for each individual customer,” and the step of “comparing the probability-based calling pattern cube for each customer to a predetermined fraudulent probability-based calling pattern.” The generation and use of probability-based calling pattern cubes and the attendant advantages are set forth in specification on page 16, line 24 to page 22, line 10.

The 9/10/2002 Final Action (page 11, first full paragraph) refers to FIGS. 3-5 and the Abstract of Fawcett et al. for teaching the above-noted claim limitations. The Abstract

describes a technique for automatically designing a fraud detection system using a series of machine learning methods. Specifically, rule-learning is used to uncover indicators of fraudulent behavior from a large user database. FIG. 3 illustrates the generic use of the fraud detection system designed in accordance with the methodology of FIG. 2. FIG. 4 illustrates a flow diagram for the selection of rules used in the profiler templates to instantiate the profilers. FIG. 5 shows the generated fraud detection system in place operating on exemplary customer account-day data.

However, after a review of the cited references, there does not appear to be any teaching of the above-noted claims limitations directed to probability-based calling pattern cube was found.

In this regard, it is respectfully requested that the Action specifically point out those portions of the cited references that teach or suggest the generation and use of probability-based calling pattern cubes as claimed.

Furthermore, the references, whether alone or in combination, fail to teach or suggest the step of when the probability-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent probability-based calling pattern, performing a first action,” as claimed.

On page 11, the Action appears to cite Fawcett as teaching the generation and use of probability-based calling pattern cube as claimed. However, the Fawcett system does not fairly teach or suggest probability-based calling pattern cube.

The Abstract, for example, describes the Fawcett technique as a fraud detection system that uses machine learning methods. Rule learning is used to uncover indicators of fraudulent behavior. The indicators are used to create profilers that are then used to generate high confidence intervention activities. FIGS. 3 to 5 of Fawcett are directed to a generic use

of the fraud detection system, a flow diagram for the selection of rules used in the profiler templates to instantiate the profilers, and a generated fraud detection system operating on exemplary customer account-day data, respectively.

The above cited portions and Col. 7, lines 30-32 of Fawcett fail to teach or suggest the generation or use of a probability-based calling pattern cube as claimed.

Fawcett Reference

Fawcett is relied upon for teaching detecting telecommunication fraud. Specifically, col. 2, lines 46-52, col. 7, lines 30-32, Abstract and FIGS. 3-5 are relied upon for teaching various claimed aspects of claims 3, 28, 30. However, it is respectfully submitted that the Fawcett reference, whether alone or in combination with the Tuzhilin reference and the Han reference, fails to teach or suggest the telecommunication fraud detection method and system, as claimed.

Furthermore, the Fawcett reference is not believed to be relevant to the claimed invention since this patent may be relied upon only to teach a technique for automatically designing a fraud detection system by using a series of machine learning methods and is not relevant to specific telecommunication fraud method and data processing system in accordance with the claims on appeal. Specifically, Fawcett, whether alone or in combination, fails to fairly teach or suggest the specific steps and structures recited by the claimed invention.

Claims 2-13, 15-20, 22-25, 29 and 30 respectively dependent on claims 27, 28 and 14, are considered allowable by virtue of their dependencies. These dependent claims are further considered allowable on their own merits as they recite other features of the invention neither taught nor suggested by the applied references.

Claim 20

Dependent claim 20 recites, “utilizing an OLAP server to create a calling profile cube, updated calling profile cubes, derive calling pattern cubes from the calling profile cube, analyzing calling pattern cubes, and comparing calling pattern cubes.” Moreover, dependent claim 20 further recites, “wherein OLAP programming supported by the OLAP server provides a scalable computation engine for generating and processing the calling pattern cubes.” It is respectfully asserted that Han, whether alone or in combination with Tuzhilin and Fawcett, fails to teach or suggest these limitations as claimed.

Claim 30

Regarding claim 30, Han page 7, section 3.4 is cited as teaching the limitations recited thereby. Han page 7, section 3.4 is directed to Mining Periodicity Patterns and does not teach or suggest the generation or use of a probability-based calling pattern cube as claimed....

Similarly, Tuzhilin, FIG. 3, col. 2, lines 41-67 is directed to “dynamic profiles to provide better recommendation to users as to which products and services each individual user can use” and does not teach or suggest the generation or use of a probability-based calling pattern cube as claimed.

Specifically, it is noted that FIG. 3 of Tuzhilin, illustrates 1) how individual rules are compressed, 2) used to generate aggregate rules, which are validated, and 3) how individual rules are validated. However, FIG. 3 of Tuzhilin does not fairly teach or suggest or is even remotely related to the generation or use of a probability-based calling pattern cube as claimed.

The Final Action and Advisory Action do not appear to address these limitations.

It is respectfully submitted that the resulting combination of references would not motivate one of ordinary skill to utilize OLAP programming supported by the OLAP server to provide a scalable computation engine for generating and processing calling pattern cubes, such as is presently claimed.

Han, Tuzhilin, and Fawcett et al. do not appear to disclose these features of the claimed invention. Moreover, it is unclear from the lengthy Final Rejection specifically how the references teach or suggest these claimed features. It would be very helpful to the appellant and consistent with proper examination practice if the Action would indicate specific elements or portions within the applied references that teach specific claimed features instead of simply parroting the language in the present claims on Appeal as alleged disclosures within the applied references.

This comment is not intended to be criticism but merely a plea for greater specificity so that the applicant/appellant may clearly understand what disclosures are being relied upon in the appropriate references to reject these dependent claims.

THE PROPOSED COMBINATION OF HAN, TUZHILIN & FAWCETT IS BASED ON IMPERMISSIBLE USE OF THE CLAIMED INVENTION AS A TEMPLATE TO PIECE TOGETHER THE TEACHINGS OF THE CITED REFERENCES.

Regarding the claims 14, 27 & 28, the Actions have proposed combining the Han reference, the Tuzhilin reference and the Fawcett reference to render obvious the claimed invention. Specifically regarding the method claims 27 & 28, Han is cited for teaching the first three claimed steps, Tuzhilin is cited for teaching the next three claimed steps, and Fawcett is cited for teaching the design of fraud detection systems.

First, it is respectfully submitted that neither the Han reference, the Tuzhilin reference nor the Fawcett reference explicitly or implicitly teaches or suggests any motivation to combine the respective teachings of the different systems to arrive at the claimed invention.

The first paragraph on page 8 of the Final Action dated 9/10/2002 states, "It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Han by the teaching of Tuzhilin to include ... with the motivation to more efficiently serve the user as taught by Tuzhilin and in order to detect any abnormal activity." The Final Action further cites column 1, lines 22 to 26 of Tuzhilin for the motivation to combine that states, "If the user profiles are generated in a highly relevant and comprehensible manner with respect to a specific user, the applications would be able to understand that user's needs better and more efficiently serve that user."

Similarly, the fourth paragraph on page 8 of the Final Action dated 9/10/2002 states, "It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Han by the teaching of Tuzhilin to include: detecting telecommunication fraud, with the motivation to more effectively generate a fraud detection system in a relatively brief time frame so that the fraud detection system is well adapted to current fraudulent schemes as taught by Fawcett." The Final Action cites column 2, lines 46 to 53 of Fawcett that states

One feature of the arrangement of the present invention is its usefulness in generating a fraud detection system in a relatively brief time frame (for example, overnight) so that the fraud detection system is well adapted to current fraudulent schemes. In addition, the fraud detection system provides measures of fraudulent activity that are not particularly intuitive, so the measures have been overlooked in conventional fraud detection systems.

Based on the above portions, the Action suggests that the Han architecture be modified with the user profiling of Tuzhilin and that the resulting combination be further combined in the fraud detection system of Fawcett. However, the Federal Circuit has stated, “The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification.” In re Fritch, 972 F.2d 1260, 23 USPQ 2d 1780, 1783–84 (Fed. Cir. 1992) [emphasis added].

The cited portions do not appear to suggest the desirability of modifying the Han reference with the teachings of Tuzhilin and Fawcett. Instead, the above portions appear only to discuss an advantage of the respective invention (e.g., an advantage of the Fawcett invention and an advantage of the Tuzhilin).

The Federal Circuit has further held In re Fritch, 972 F.2d 1260, 23 USPQ 2d 1780, 1783 (Fed. Cir. 1992):

In proceedings before the Patent and Trademark Office, the Examiner bears the burden of establishing a prima facie case of obviousness based upon the prior art. ... “[The Examiner] can satisfy this burden only by showing some objective teaching in the prior art ... would lead that individual to combine the relevant teachings of the references. In re Fine, 837 F.2d 1071, 1074, 5 USPQ 2d 1596, 1598 (Fed. Cir. 1988). [emphasis added.]

It is respectfully submitted that the references do not suggest the desirability of the suggested modification. Consequently, it appears that the current patent application has been improperly used as a basis for the motivation to combine or modify the components selected from Han, Tuzhilin, and Fawcett to arrive at the claimed invention.

However, the Federal Circuit has ruled, “It is impermissible to use the claimed invention as an instruction manual or “template” to piece together the teachings of the prior

art so that the claimed invention is rendered obvious. This court has previously stated, “[o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention.” (quoting *In re Fine*, 837 F.2d 1071, 1075, 5 USPQ 2d 1596, 1600 (Fed. Cir. 1988)), *In re Fritch*, 23 USPQ 2d 1780, 1784 (Fed. Cir. 1992). [emphasis added.]

The Federal Circuit further held:

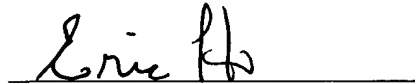
The genius of invention is often a combination of known elements which in hindsight seems preordained. To prevent hindsight invalidation of patent claims, the law requires some "teaching, suggestion or reason" to combine cited references. *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573, 1579, 42 USPQ 2d 1378, 1383 (Fed. Cir. 1997). When the art in question is relatively simple, as is the case here, the opportunity to judge by hindsight is particularly tempting. Consequently, the tests of whether to combine references need to be applied rigorously. *McGinley v. Franklin Sports Inc.*, 60 USPQ 2d 1001, 1008 (Fed. Cir. 2001).

Hindsight reconstruction may not be used to pick some components from Han and some other components from Tuzhilin and some other components from Fawcett to arrive at the invention as claimed. Accordingly, it is respectfully requested that the rejection of claims 2-14, 15-18, 20, 22-25 and 27-30 under 35 U.S.C. 103(a) be withdrawn.

CONCLUSION

For the reasons advance above, Appellant respectfully contends that each claim is patentable. Therefore, reversal of all rejections is courteously solicited.

Respectfully submitted,



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I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date below.



Eric Ho

August 9, 2003

(Date)

APPENDIX

2. A method as in claim 27 wherein said data warehouse has a call table and a profile table, wherein the step of generating a calling profile cube based on the records further comprises the steps of:

retrieving records from the call table and based thereon generating a snapshot cube representing the records from the call table, said snapshot cube having predetermined dimensions;

retrieving records from the profile table and based thereon generating a profile cube representing the records from the profile table, said profile cube having predetermined dimensions that are the same as the dimensions of the snapshot cube;

merging the snapshot cube and the profile cube to generate an updated profile cube;
and

deriving the volume-based calling pattern cubes based on the updated profile cube.

3. A method as in claim 27 wherein the step of when the volume-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent volume-based calling pattern, performing a first action includes one of:

flagging a particular caller with the volume-based calling pattern being analyzed as suspicious;

automatically generating an alert that specifies callers with suspicious volume-based calling pattern;

performing further investigation on callers with suspicious volume-based calling pattern;

cancellation of telephone services for callers with suspicious volume-based calling pattern; and

performing other appropriate remedial actions.

4. A method as in claim 27 further comprising:
analyzing the calling pattern cube by utilizing at least one OLAP operation.
5. A method as in claim 4 wherein said OLAP operations is one of a roll-up operation, a drill-down operation, a dice operation, a slice operation, and an ad-hoc query.
6. A method as in claim 27 wherein the predetermined fraudulent volume-based calling pattern in one of a personalized calling pattern and a group-based pattern.
7. A method as in claim 2 further comprising:
storing the updated profile cube into the profile table in the data warehouse; and
performing data staging between the profile table and the updated profile cube at
predetermined time intervals.
8. A method as in claim 2 wherein said profile cube, snapshot cube, and updated profile cube each includes at least two dimensions and at least two levels.
9. A method as in claim 8 further comprising:
analyzing the calling pattern cube by utilizing at least one OLAP operation along more
than one level.
10. A method as in claim 8 further comprising:
analyzing the calling pattern cube by utilizing at least one OLAP operation along more
than one dimension.
11. A method as in claim 2 wherein the profile cube, snapshot cube, and the updated profile cube each are multi-level and multi-dimensional cubes.

12. A method as in claim 2 wherein the profile table and the call table each has a plurality of attributes, and the profile cube and snapshot cube each has a plurality of dimensions, said attributes corresponding in a one-to-one fashion to the dimensions.
13. A method as in claim 2 wherein the profile cube includes at least one cell having probability based values.
14. A data processing system comprising:
 - a data warehouse for storing data in a relational format, said data warehouse including a profile table and a call table;
 - an OLAP server, coupled to the data warehouse, for providing predetermined OLAP operations; and
 - a profile engine, coupled to the data warehouse for computing, maintaining and utilizing caller pattern cubes that represent caller profiles; wherein the caller pattern cubes can be utilized to detect telecommunication fraud.
15. A data processing system as in claim 14 further comprising:
 - a fraud detection module for detecting telecommunication fraud by comparing known fraudulent profiles to caller pattern cubes;
 - the profile engine further generating a profile cube from information selected from the profile table, generating a snapshot cube, updating the profile cube by merging the profile cube and the snapshot cube to generate an updated profile cube, and deriving a calling pattern cube based on the updated profile cube; wherein the profile engine is a scalable computation engine that is implemented by OLAP programming supported by the OLAP server.
16. A data processing system as in claim 14 further comprising:

an analysis tool for use by a data analyst to perform one of comparing the calling pattern cube to known fraudulent calling pattern cube and extracting information from the calling pattern cube based on selected dimensions, levels, and ad-hoc queries provided by the data analyst.

17. A data processing system as in claim 14 further comprising:
a visualization tool for use by a data analyst to display the calling pattern cube in different formats, levels, and dimensions.
18. A data processing system as in claim 14 further comprising:
a data staging tool for transferring data between the profile cube stored in the OLAP server and profile table in the data warehouse at predetermined time intervals.
20. A method as in claim 27 further comprising:
utilizing an OLAP server to create a calling profile cube, updated calling profile cubes, derive calling pattern cubes from the calling profile cube, analyzing calling pattern cubes, and comparing calling pattern cubes;
wherein OLAP programming supported by the OLAP server provides a scalable computation engine for generating and processing the calling pattern cubes.
22. The method of claim 28 wherein the calling profile cube is a multi-dimensional and a multi-level cube and wherein the volume-based calling pattern cubes are multi-dimensional and a multi-level cubes.
23. The method of claim 28 further comprising:
performing data staging at predetermined time intervals; and
updating the calling profile cube by generating a snapshot cube from a call table; and

merging the snapshot cube with the calling profile cube to generate an updated calling profile cube.

24. The method of claim 28 wherein the calling profile cube has a cell that includes a probability distribution value based on one of the probability distribution on calls to each callee and the probability distribution on all calls.
25. The method of claim 22 wherein the dimensions include a day-of-week hierarchy, a time hierarchy, and a duration hierarchy.
27. A method for detecting telecommunication fraud performed in a data processing system having a data warehouse and an OLAP server, the method comprising:
 - retrieving a plurality of call records from the data warehouse;
 - generating a calling profile cube based on the call records; wherein the calling profile cube includes information on multiple customers;
 - generating a volume-based calling pattern cube for each individual customer based on the multi-customer calling profile cube;
 - comparing the volume-based calling pattern cube for each customer to a predetermined fraudulent volume-based calling pattern; and
 - when the volume-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent volume-based calling pattern, performing a first action.
28. A method for detecting telecommunication fraud performed in a data processing system having a data warehouse and an OLAP server, the method comprising:
 - retrieving a plurality of call records from the data warehouse;
 - generating a calling profile cube based on the call records; wherein the calling profile cube includes information on multiple customers;

generating a volume-based calling pattern cube for each individual customer based on the multi-customer calling profile cube;
generating a probability-based calling pattern cube based on the volume-based calling pattern cube for each individual customer;
comparing the probability-based calling pattern cube for each customer to a predetermined fraudulent probability-based calling pattern;
when the probability-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent probability-based calling pattern, performing a first action.

29. A method as in claim 28 wherein the step of when the probability-based calling pattern cube is in a first predetermined relationship with predetermined fraudulent probability-based calling pattern, performing a first action includes one of:

flagging a particular caller with the probability-based calling pattern being analyzed as suspicious;
automatically generating an alert that specifies callers with suspicious probability-based calling pattern;
performing further investigation on callers with suspicious probability-based calling pattern;
cancellation of telephone services for callers with suspicious probability-based calling pattern; and
performing other appropriate remedial actions.

30. The method of claim 29 wherein the probability-based calling patterns enables one of the analysis and comparison of a first probability-based calling patterns that covers a first time period with a second probability-based calling patterns that covers a second time period.